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A simulated bushfire test report

An external construction tested in accordance with AS 1530.8.1:2018

Test sponsor: AllState Polystyrene Industries Pty Ltd

Product: StateWall® Render System

Bushfire attack level (BAL) exposure: 29kW/m^2 Crib class: AA

Job number: FRT190048

Test date: 21 March 2019 Revision: R1.0

Amendment schedule

Version	Date	Information relating to report			
R1.0	15/04/2019	Description	Initial issue		
			Prepared by	Reviewed by	Authorised by
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General conditions of use

Executive summary

This report documents the findings of a simulated bushfire attack – radiant heat and small flaming sources test of elements of construction for buildings undertaken on 21 March 2019 in accordance with Clause 14 and 15 of AS 1530.8.1:2018.

The test specimen consisted of two 90 × 45 timber stud frames; the central frame offset 250mm back incorporating an 800mm × 800mm aluminium framed window and eaves detail. The unexposed side was clad with 10mm Gyprock plasterboard while the exposed side had a 3.9mm thick (measured) StateWall® render applied over 75mm StateWall® EPS cladding. A 5mm wide control joint was incorporated into the wall system at the north window reveal, extending the entire height of the main wall. The control joint was sealed to a depth of 30mm using Sika® Sikasil® 670 Fire, fire rated silicone sealant.

A summary of the results achieved by the test specimen is provided in Table 1.

Table 1 Test results

Performance criteria		Time to failure (min.)	Position of failure
Formation of through-gaps greater than 3mm		No failure	-
Sustained flaming for 10s on the non-fire side		No failure	-
Flaming on the fire-exposed side at the end of the 60 minute test period		No failure	-
Radiant heat flux 365mm from the non-fire side exceeding 15kW/m^2		Not Applicable	-
Mean and maximum temperature rises greater than 140K and 180K		No failure	-
Radiant heat flux 250mm from the specimen, greater than 3kW/m^2 between 20 min and 60 min		*	*
Mean and maximum temperature of internal faces exceeding 250°C and 300°C respectively between 20 min and 60 min after commencement of test		No failure	-
Crib class	AA	**Peak heat flux**	29kW/m^2
Test result		**BAL— AA29**	

Note: * Heat flux gauge positioned 250mm from the specimen was not connected

Contents

1. Introduction

This report documents the findings of a simulated bushfire attack – radiant heat and small flaming sources test of elements of construction for buildings undertaken on 21 March 2019 in accordance with Clause 14 and 15 of AS 1530.8.1:2018.

Warringtonfire Australia did the test at the request of AllState Polystyrene Industries Pty Ltd.

Table 2 Test sponsor details

Test sponsor	Address
AllState Polystyrene Industries Pty Ltd	26-28 Elliot Road Dandenong South VIC 3175 Australia

2. Construction details

Table 3 provides details of the test assembly. Table 4 provides a summary of the test specimen. A full description of the specimen is provided in Appendix A and Section 3.

Table 5 shows the installation method and orientation of the test specimen.

Table 3 Test assembly

Item	Detail	
Wall system	90 x 45 timber stud frame clad with the StateWall® 75mm thick M-grade EPS and StateWall® render on the exposed side, and 10mm standard plasterboard on the unexposed side.	
Nominal wall size	Width (w): Height (h): Thickness (t):	3000mm 3000mm 179mm

Table 4 Test specimen

Item	Detail
Test specimen	The wall system consisted of two 90 × 45 timber stud frames; the central frame offset 250mm back incorporating an 800mm × 800mm aluminium framed window and eaves detail. The unexposed side was clad with 10mm Gyprock plasterboard while the exposed side had a nominal 3.9mm thick (measured) StateWall® render applied over 75mm thick StateWall® EPS cladding. A 5mm wide control joint was incorporated into the wall system at the north window reveal, extending the entire height of the main wall. The control joint was sealed to a depth of 30mm using Sika® Sikasil® 670 Fire, fire rated silicone sealant.

Table 5 Installation method and orientation

Item	Detail
Start date of panel and mesh construction	21 February 2019
First basecoat render applied on	21 February 2019
Second basecoat render applied on	21 February 2019

Item	Detail
Unexposed cladding, framing materials and window sourced by	Representatives of Warringtonfire Melbourne.
Exposed cladding, render and other building material supplied by	The test sponsor.
Timber framing constructed by	Representatives of Warringtonfire Melbourne.
Orientation	Asymmetrical, The exposed side of the wall was coated with rendered EPS foam and the unexposed side was clad with plasterboard. It was confirmed that the system was exposed to heat from the side that would normally face the outside of the building.

3. Schedule of components

Table 6 lists the schedule of components for the test specimen which were provided by the test sponsor and surveyed by Warringtonfire Australia.

Table 6 Schedule of components

Item	Description	
Substrate		
1.	Product name	75mm StateWall® board
	Material	M-grade EPS (Expanded Polystyrene)
	Size	2500mm high × 1200mm wide × 75mm thick (nominal uncut, measured)
	Density	19.7 kg/m^3 (measured)
	Location/fixing	One layer across both exposed face levels and up north and south return walls. 10g × 100mm bugle head galvanised external wall screws (item 15) with Ø45mm plastic washers (item 16) at nominal 400mm centres fixed directly to the timber framing (item 11).
Render system		
2.	Moisture	2.86% of dry mass (measured)
	Density	1474 kg/m^3 (measured)
	Thickness (total)	3.9mm mean thickness (measured) Specimen varied between a minimum thickness of 3.0mm to a maximum thickness of 4.5mm across 16 core samples taken from the tested specimen.
a.	Product	StateWall® render
	Thickness	First coat – Nominal 2.0mm Second coat – Nominal 2.0mm
	Location	First layer applied directly over boards (Item 1). Mesh (Item 2b) was then pushed into the basecoat. A second coat was applied on the same day.
b.	Product	StateWall® - Wall mesh – Alkaline resistant fibreglass mesh
	Size	Mesh size 5mm × 5mm, 1185mm tall sheet, full width of wall
	Location	Embedded in first render layer (Item 2a).
Wraps, sealants and miscellaneous		
3.	Product name	Ametalin Silverwrap MD sarking
	Material	Breathable Film/Non- Woven Polyolefin
	Size	1350mm tall sheet, full width of wall
	Location	Single layer with nominal 50mm overlap on exposed side of timber framing.
	Fixing	Stapled to the timber framing at nominal 300mm centres.
4.	Product name	Sika® Sikasil® 670 Fire
	Material	Fire resistant silicone sealant
	Location	Installed in the 5mm wide vertical control joint located along the north vertical edge of the window (item 10) to a depth of 30mm.
5.	Product name	PE/Render Tape
	Material	Polyethylene
	Location	48mm wide

Item	Description	
	Size	Applied around perimeter of window (Item 10) with nominally 25mm on the wall and 23mm on the window frame.
6.	Product name	BOSMAN PU Glue Foam
	Location	Sealing joins between panels (Item 1). Applied to all edge interfaces of the panels.
7.	Product name	Starting Channel
	Material	Aluminium
	Size	43mm × 80mm × 26mm (measured)
	Location	Channel was fixed to bottom of the wall and over wall wrap.
8.	Product name	Meshed External Angle
	Material	Aluminium with Alkali Resistant Mesh
	Size	25mm × 25mm, with 130mm × 75mm mesh
	Location	Angles embedded into first render coat; around outer perimeter edge of wall specimen (vertical edges only), window (top and vertical edges only) and two vertical pieces at the wing wall/return wall edges.
Unexposed cladding		
9.	Product name	Gyprock 10mm Plasterboard
	Size	1200mm wide × 3000mm long sheets cut to suit.
	Density	660 kg/m^3 (measured)
	Location	Clad horizontally on the unexposed side of the timber framing.
	Fixing	32mm × 6g Bugle Head Drill Point Fine Thread ZY Plasterboard Screws at nominal 300mm centres.
Window		
10.	Frame	Extruded aluminium
	Glazing	5TF Grade A safety glass – 5mm thick toughened glass
	Size	Outer dimensions: Nominal 8000mm wide × 800mm high × 52mm deep Inner dimensions: 70mm wide × 720mm high (to glazing)
Framing		
11.	Product name	90×45 MGP10 Radiata pine
	Density	489 kg/m^3 (measured)
	Location	Refer to Figure 1 and Figure 2 for frame details.
Lining		
12.	Eave cladding	4.5mm Gyprock Fibre-cement sheet
13.	Sill cladding	13mm Gyprock Fyrchek plasterboard
14.	Sill cladding	6mm Gyprock Fibre-cement sheet
Fixings		
15.	Product name	External wall screws
	Description	10g × 100mm long galvanised bugle torx drive head needle point screws
	Location	Used in conjunction with the plastic washers (item 16) to secure the EPS boards (item 1) to the timber framing at nominal 400mm centres and 50mm away from the board edges.
16.	Product name	Plastic Washer
	Description	Ø45mm Polyethylene washer

Item	Description	
	Location	Used in conjunction with the external wall screws (item 15) to secure the EPS render boards (item 1) to the timber framing at 400mm centres.

4. Test procedure

Table 7 details the test procedure for this simulated bushfire test.

Table 7 Test procedure

Item	Detail	
Statement of compliance	The test was performed in accordance with the requirements of clause 14 and 15 of AS 1530.8.1:2018 as appropriate external walls, subject to the variations below.	
Variations	• The heat flux gauge located 250mm from the exposed face of the specimen was not connected, however the observations indicate no heat flux failure.	
Pre -test conditioning	The construction of the test specimen was completed on 21 February 2019 and given a curing time of 28 days before the test. The test specimen was subjected to normal laboratory temperatures and conditions between the completion of construction of the specimen and the start of the test.	
Sampling / specimen selection	The laboratory was not involved in sampling or selecting the test specimen for the simulated bushfire test.	
Ambien laboratory temperature	Start of the test Minimum temperature Maximum temperature	27°C 27°C 31°C
Test duration	The test was stopped after 60 minutes in accordance with the procedures in AS 1530.8.1:2018.	
Instrumentation and equipment	The instrumentation was provided in accordance with AS 1530.8.1:2018 as detailed below: • The non-fire side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5mm soldered to 12mm diameter × 0.2mm thick copper discs covered by 30mm × 30mm × 2.0mm inorganic insulating pads. The thermocouple positions are shown in Table 10 and Figure 5 in Appendix D. • Radiant heat flux measurements to determine the irradiance transmitted from the exposed face of the specimen were taken using Medtherm heat flux gauges. • During calibration, a heat flux gauge was centrally located next to the specimen at a distance equal to the leading surface of the specimen. A second heat flux gauge was located close to the vertical centre of the specimen, at the leading edge, in the south wall section at a height of 2265mm from the floor. • During the test, the heat flux gauge that was 2265mm from the floor remained in place, using values found during an ancillary pre-test calibration to determine the heat flux at the leading edge of the glazing. • The heat flux gauge positions are shown in Figure 5 in Appendix E. • A 3mm gap gauge was available during the test to assess the performance of the test specimen under the criteria of integrity. • A roving thermocouple was available to measure temperatures at positions that appeared hotter than the positions monitored by the fixed thermocouples. • A pilot ignition source was available to assess any areas of the specimen producing significant quantities of volatiles. • The crib was conditioned for at least 24 hours in a conditioning oven and removed 1 hour before the start of the test.	

	• The crib was weighed to confirm that it was within the 0.152 ± 0.03kg mass required by the standard. The crib was lit over a 2 minute period – 20 seconds on the upper 0.10m × 0.10m face – 20 seconds on each of the 0.54m × 0.10m faces and a further 20 seconds on the upper 0.10m × 0.10m face using an oxy/acetylene torch with Type 551 size 8 × 10 heating tip. (Type AA crib)

5. Test measurements and results

The radiation and temperature measurements taken from the specimen are included in Appendix E. Table 9 in Appendix B includes observations of any significant behaviour of the specimen and details of the occurrence of the various performance criteria specified in AS 1530.8.1:2018. Photographs of the specimen are included in Appendix F.

Table 8 shows the results the specimen achieved against the performance criteria listed in Clause 14 and 15 of AS 1530.8.1:2018 subject to the variations listed in Section 4.

Table 8 Test results

Performance criteria		Time to failure (min.)	Position of failure
Formation of through-gaps greater than 3mm		No failure	-
Sustained flaming for 10s on the non-fire side		No failure	-
Flaming on the fire-exposed side at the end of the 60 minute test period		No failure	-
Radiant heat flux 365mm from the non-fire side exceeding 15kW/m^2		Not Applicable	-
Mean and maximum temperature rises greater than 140K and 180K		No failure	-
Radiant heat flux 250mm from the specimen, greater than 3kW/m^2 between 20 min and 60 min		*	*
Mean and maximum temperature of internal faces exceeding 250°C and 300°C respectively between 20 min and 60 min after commencement of test		No failure	-
Crib class	AA	**Peak heat flux**	29kW/m^2
Test result		**BAL— AA29**	

Note: * Heat flux gauge positioned 250mm from the specimen was not connected

6. Application of test results

6.1 Test limitations

The results of these fire tests may be used to directly assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard under all fire conditions.

These results only relate to the behaviour of the specimen of the element of the construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use, and they do not necessarily reflect the actual behaviour in fires.

6.2 Variations from the tested specimen

This report details methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested in accordance with test method in AS 1530.8.1:2018. Any significant variation with respect to size, construction details, loads, stresses, edge or end conditions, other than that allowed under the field of direct application in the relevant test method, is not covered by this report.

It is recommended that any proposed variation to the tested configuration – other than as permitted under the field of direct application specified in Appendix C – should be referred to the test sponsor. They should then obtain appropriate documentary evidence of compliance from Warringtonfire Australia Pty Ltd or another registered testing authority.

6.3 Uncertainty of measurements

It is not possible to provide a stated degree of accuracy for the result, because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance.

Appendix A Drawings of test assembly

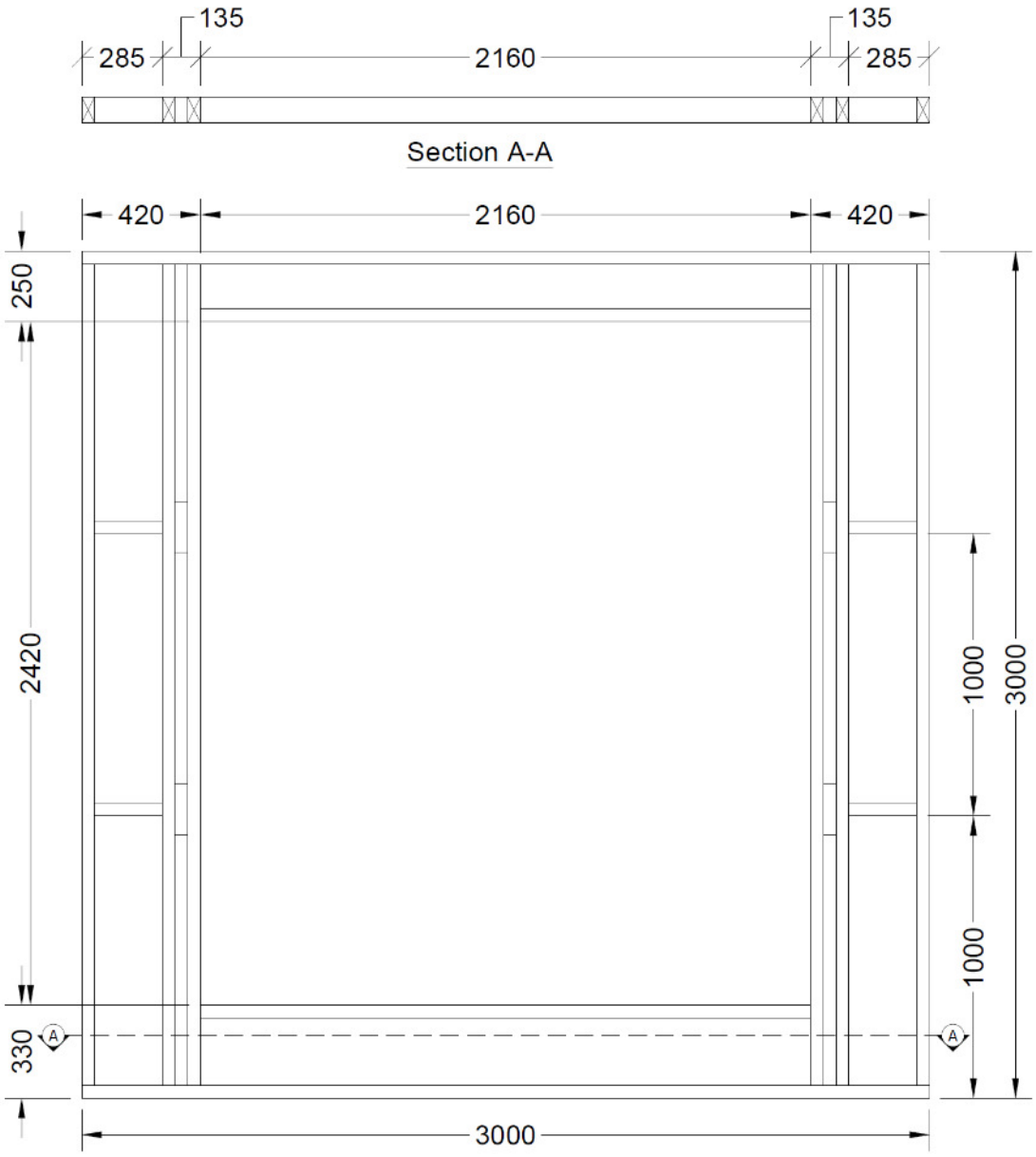


Figure 1 Elevation of front frame

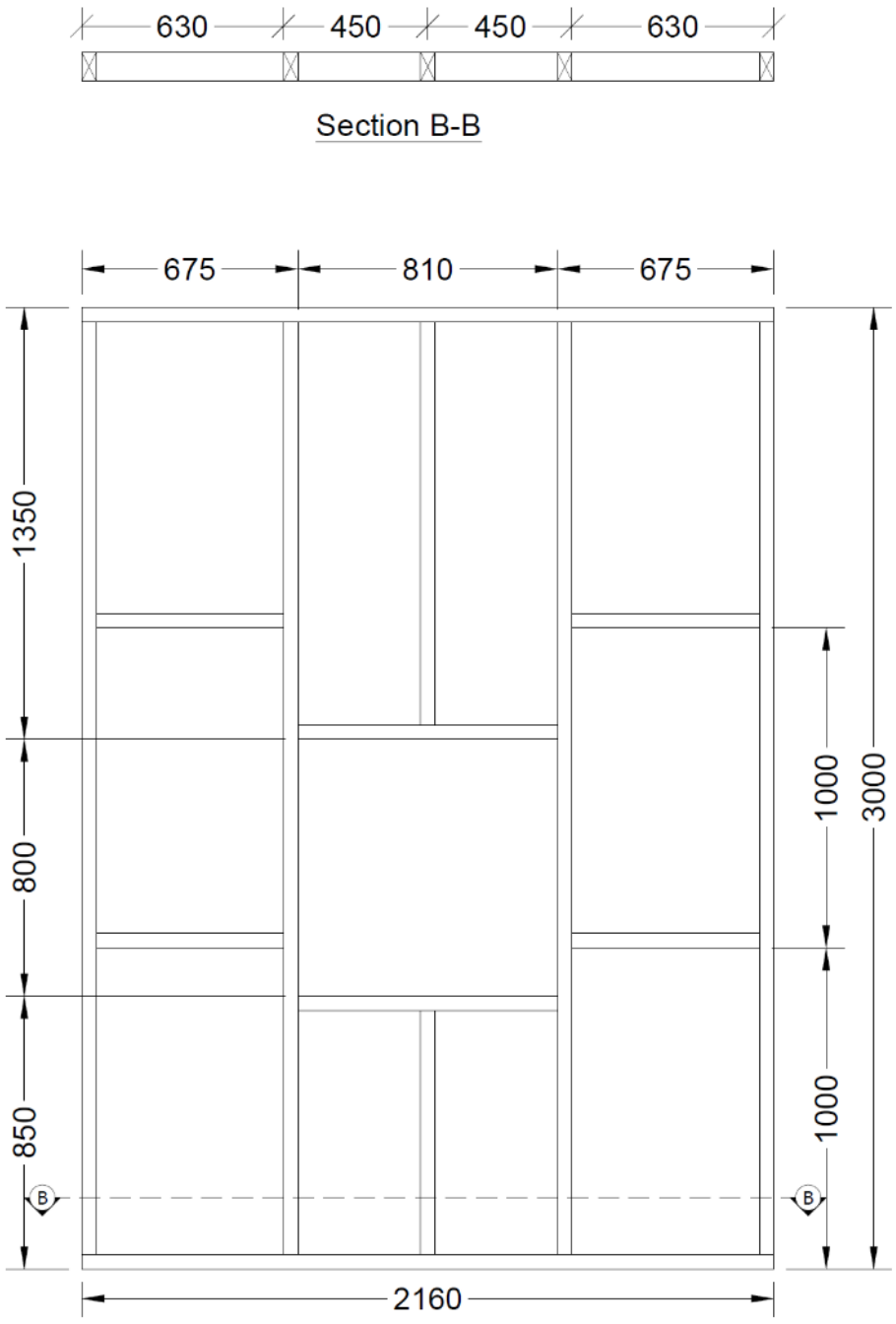


Figure 2 Elevation of rear frame

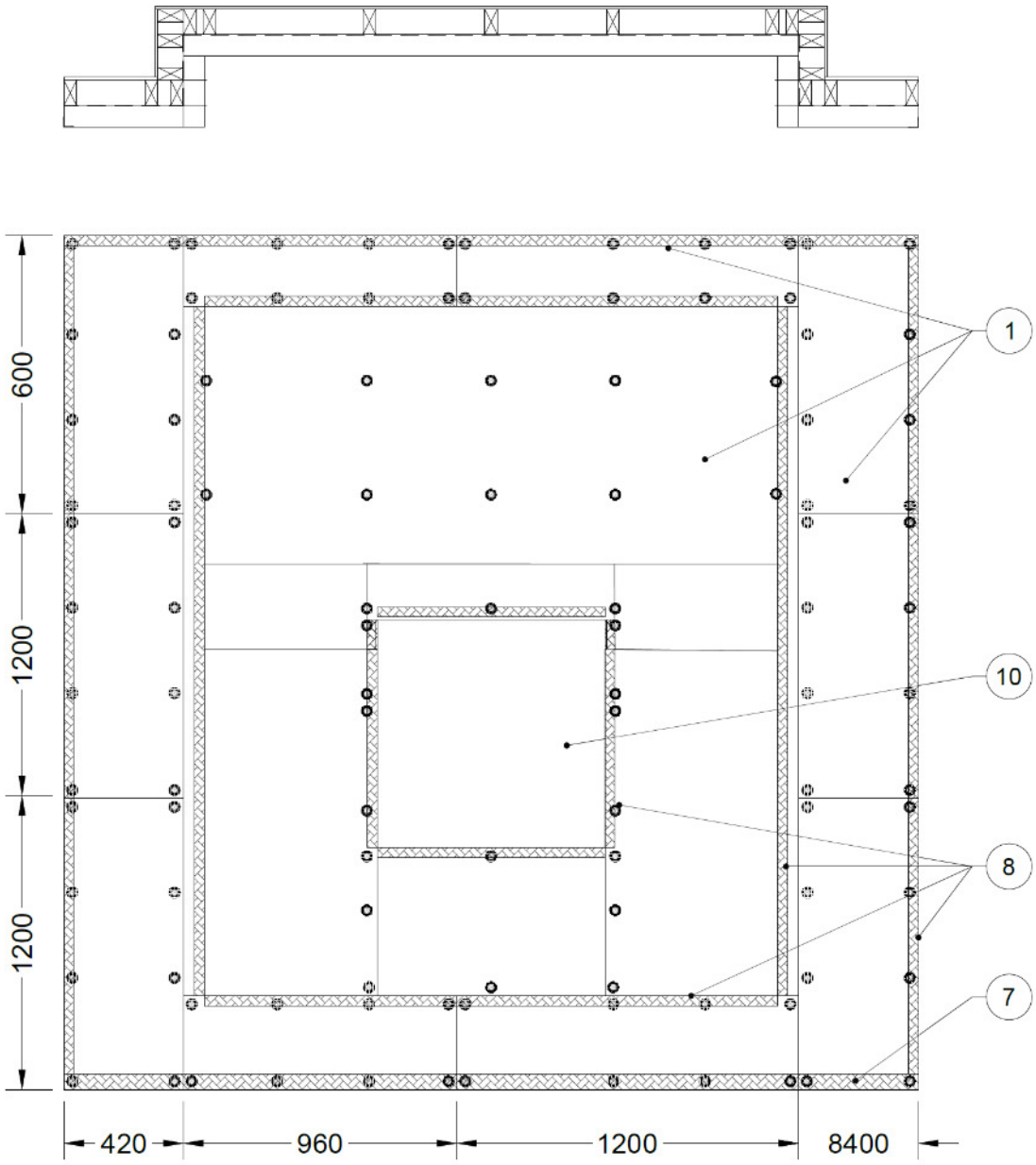


Figure 3 Elevation of exposed face before the application of render

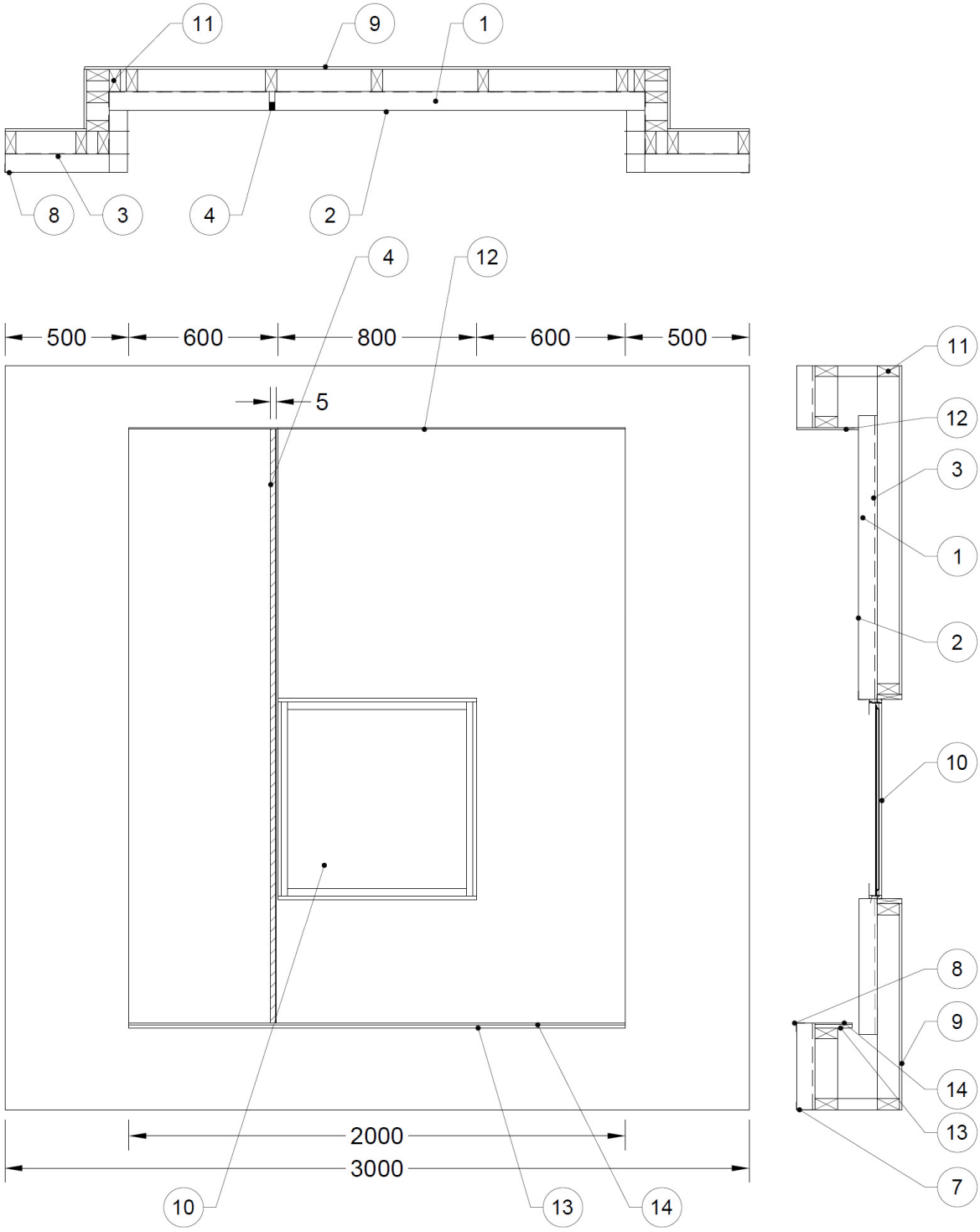


Figure 4 Elevation of exposed face and vertical section

Appendix B Test observations

Table 9 shows observations of any significant behaviour of the specimen during the test.

Table 9 Test observations

Time		Observation
Min	Sec	
00	00	Bushfire test commenced and two burning cribs were placed against the specimen.
00	03	The screen was removed, and the specimen was exposed to the radiant heat profile for BAL 29 as specified in AS 1530.8.1-2018.
00	51	The walls adjacent to the south crib had discoloured.
01	20	Light smoke emission was evident from the face of the specimen.
01	30	Cracking of render below the sill on the front face.
02	13	Entire front face of the specimen had discoloured.
02	20	The intumescent seal around the sill of the window frame had begun to expand.
02	37	Render along the head of the specimen had partially detached.
03	27	The EPS had melted away along the head and exposed the sarking.
10	00	Screen positioned in front of the furnace and exposure to the radiant heat profile for BAL 29 ceased.
13	00	Both the cribs had self-extinguished are were no longer flaming. No further flaming evident from the specimen up to the point of test termination.
60	00	No further changes to the specimen observed. The bushfire test was stopped in accordance with the procedures of AS 1530.8.1-2018.

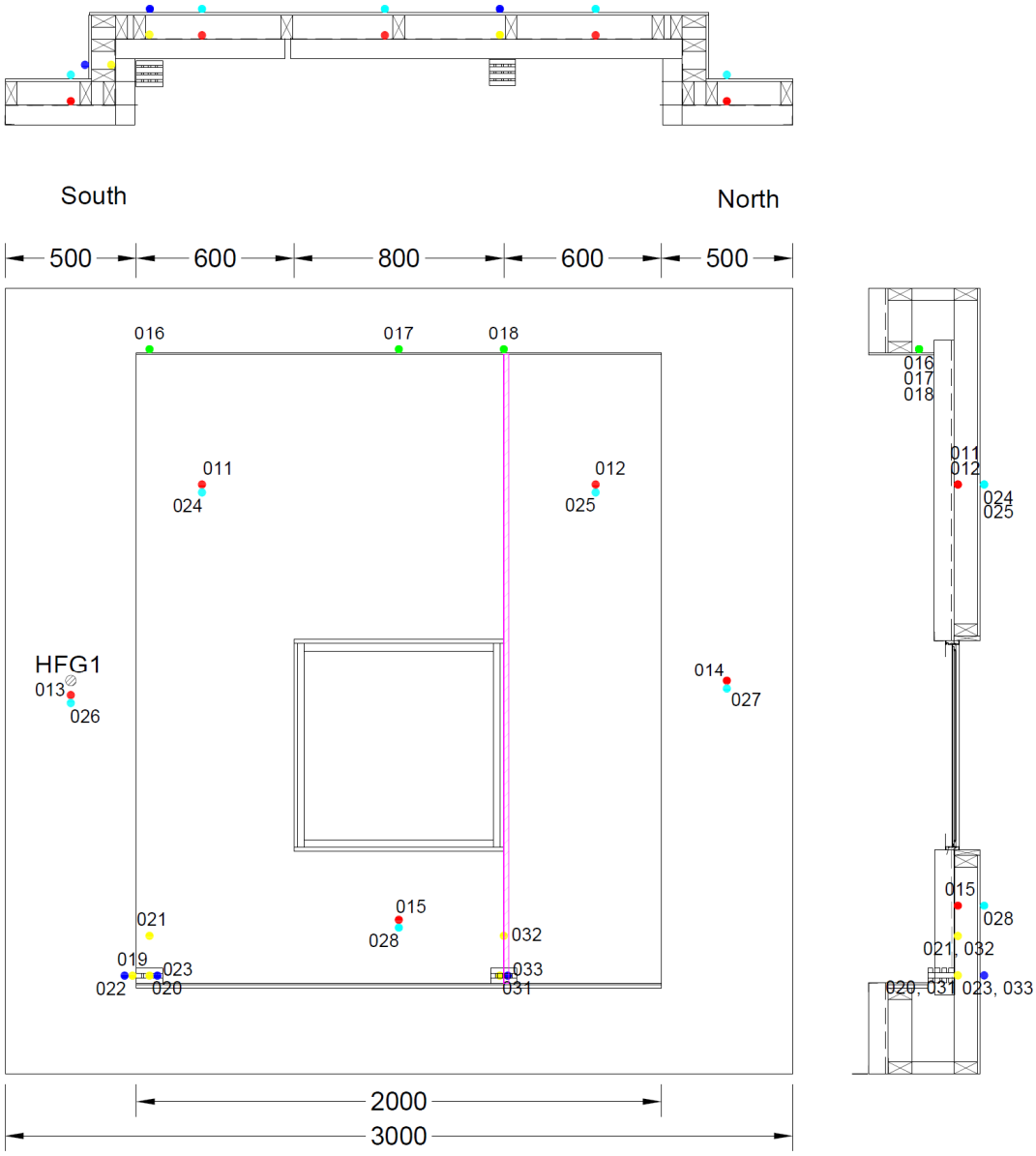
Appendix C Direct field of application

Note: The text, figures and tables in this appendix have been taken from AS 1530.8.1:2018.

The results of the fire test contained in this test report are directly applicable to similar constructions where one or more of the following changes have been made, provided no individual component is removed of reduced:

- Increase in length of a wall of identical construction to the specimen.
- Increase in thickness of the wall.
- For framed walls –
  - increase in timber density
  - increase in cross-sectional dimensions of the framing element(s)
  - increase in steel thickness, up to a maximum of 2mm
  - decrease in sheet or panel sizes
  - decrease in stud spacing
  - decrease in fixing centres of wall sheet materials

Appendix D Instrumentation positions



LEGEND:

- = Incipient fire spread thermocouple positions—Mean temperature rise
- = Incipient fire spread thermocouple positions—Maximum temperature rise
- = Incipient fire spread thermocouple positions—Eaves mean and maximum
- = Non fire side thermocouple positions—Mean temperature rise
- = Non fire side thermocouple positions—Maximum temperature rise

Figure 5 Indicative thermocouple locations (exposed face)

Note: Northern crib located on the sill at the vertical control joint

Southern crib located on the sill adjacent to the rear and south walls

The instrumentation was positioned in accordance with the requirements of Clause 15 AS 1530.8.1:2018 as summarised below and in Table 10.

- Heat flux gauge 1 (HFG 1) was located at the mid-height of the specimen at a distance of 250mm from the south edge, on the exposed face.

Table 10 Thermocouple location

Location	T/C no.	x	y	Description
Internal quarter points	011	750	2250	Internal cavity surfaces – mean temperature rise.
	012	2250	2250	
	013	250	1500	
	014	2750	1500	
	015	1500	540	
External quarter points	024	750	2250	Unexposed face – mean temperature rise.
	025	2250	2250	
	026	250	1500	
	027	2750	1500	
	028	1500	600	
Eaves	016	2450	2755	Internal surface of eaves – maximum and mean temperature rise.
	017	1500	2755	
	018	1095	2755	
South crib	019	325	380	Internal cavity surfaces – maximum temperature rise next to southern crib.
	020	550	380	
	021	550	530	Internal cavity surface – maximum temperature rise above southern crib.
	022	325	380	Unexposed face – maximum temperature rise next to southern crib.
	023	550	380	
North crib	031	1095	382	Internal cavity surfaces – maximum temperature rise next to northern crib.
	032	1095	530	Internal cavity surfaces – maximum temperature rise above northern crib.
	033	1095	382	Unexposed face – maximum temperature rise next to northern crib.
Heat Flux Gauge Position	HFG1	2750	1500	Embedded in surface of exposed face.

Appendix E Test data

E.1 Heat flux measurements

Before the test, the heat flux emitted by the radiant panel was measured at the centre and quarter points. The results are shown Figure 6 at a distance of 3m.

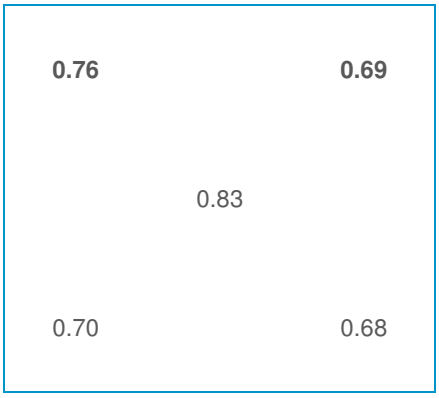


Figure 6 Heat flux emitted by the radiant panel

The average of the irradiance received at each of the quarter points was 85% of that at the central point and satisfied the minimum requirements of Clause 13.3 of AS 1530.8.1:2018.

E.2 Measure of heat flux received

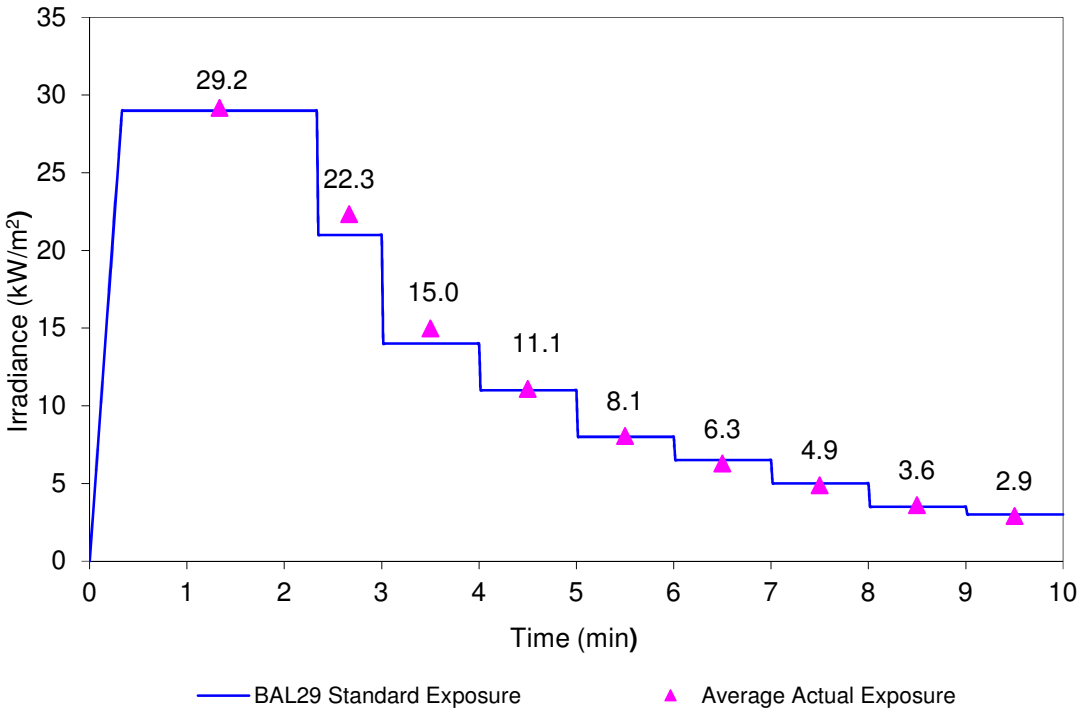


Figure 7 Averaged irradiance levels during the test to the external facade

E.3 Specimen temperatures

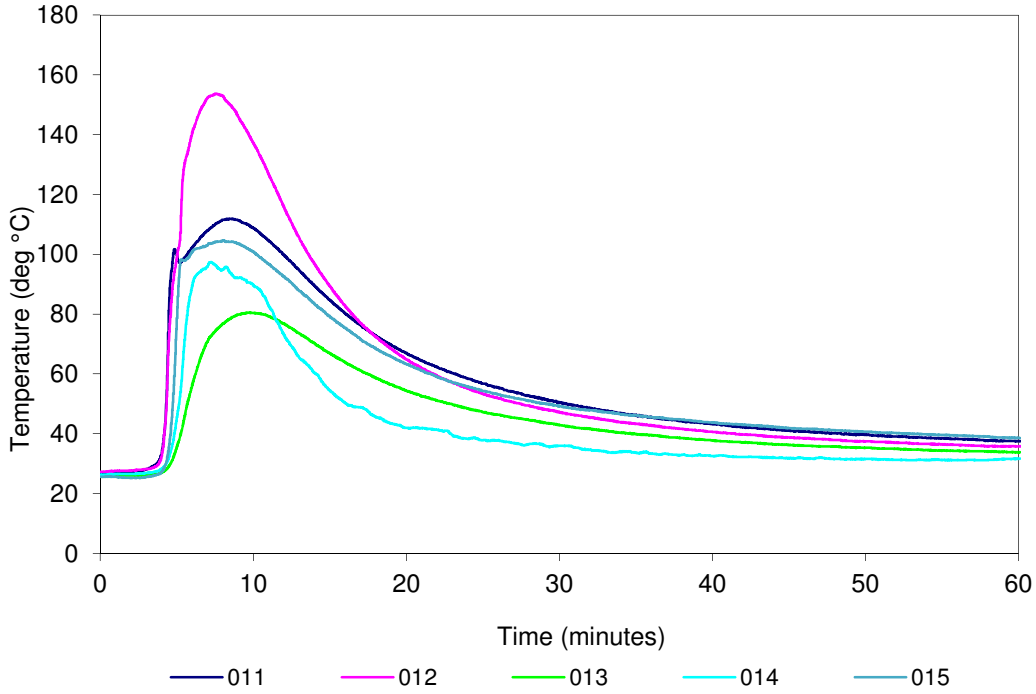


Figure 8 **Internal quarter points – temperature vs time**

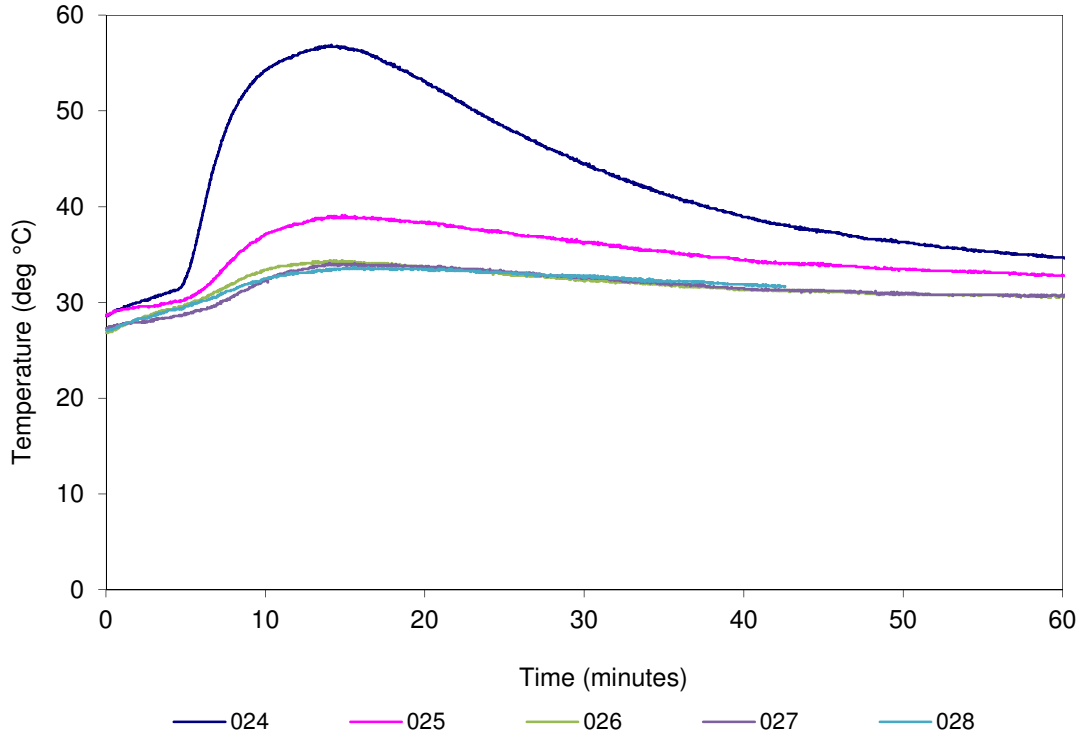


Figure 9 **External quarter points – temperature vs time**

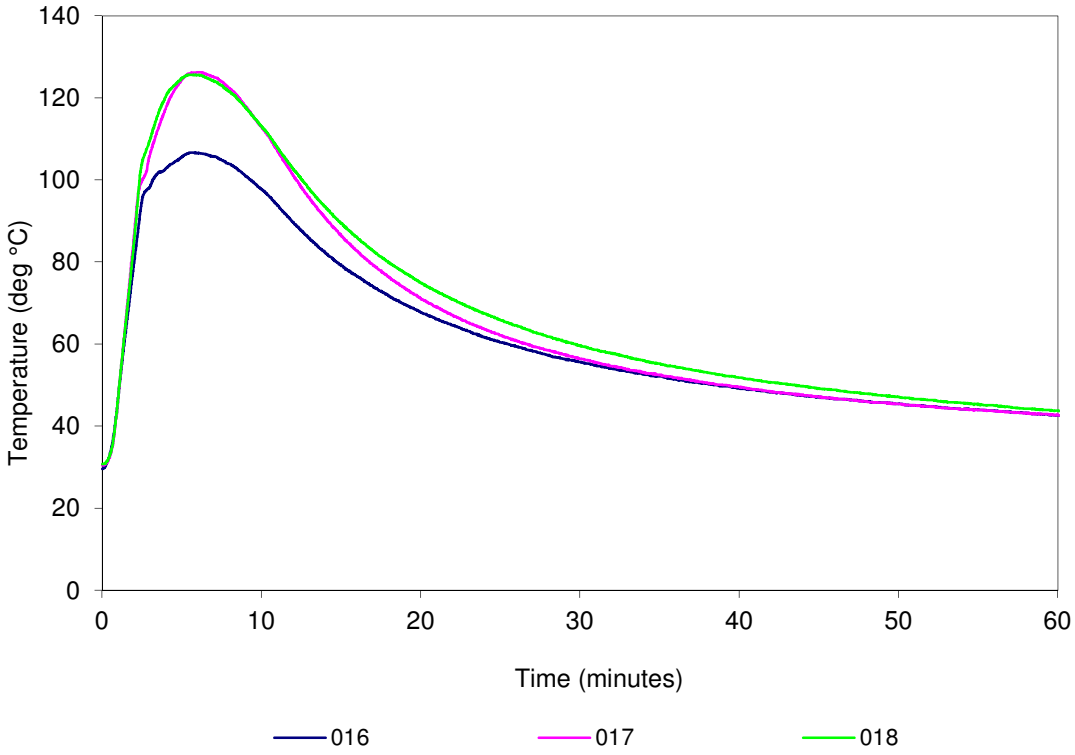


Figure 10 **Eaves – temperature vs time**

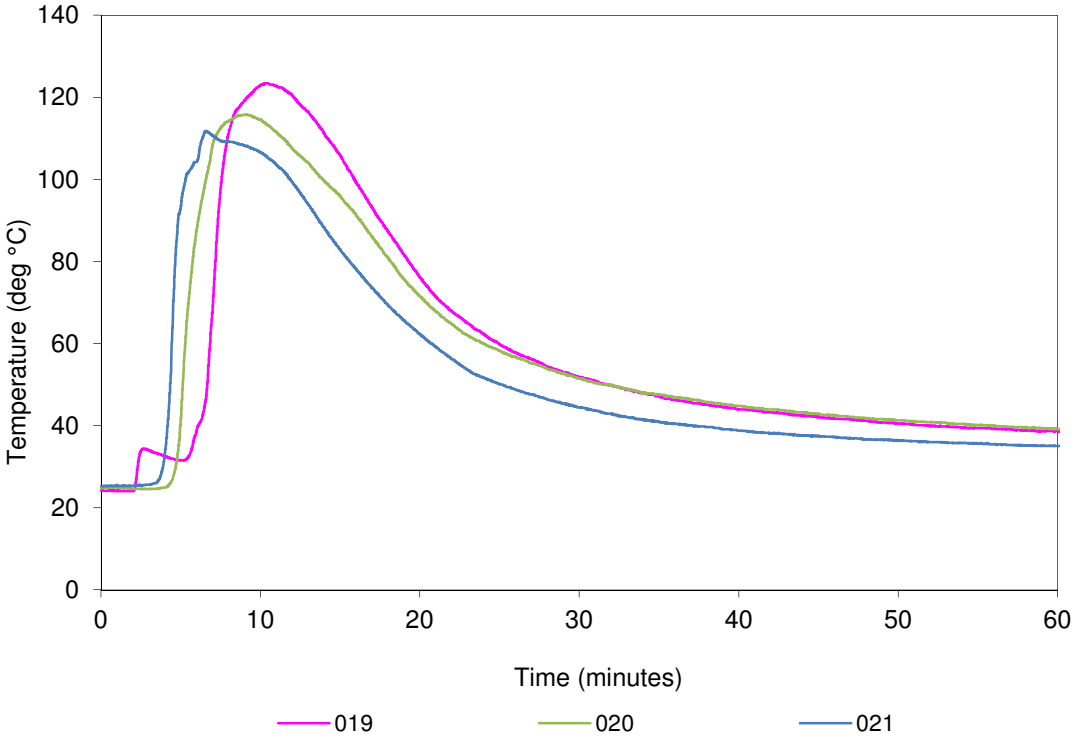


Figure 11 **South crib – temperature vs time, internal around crib**

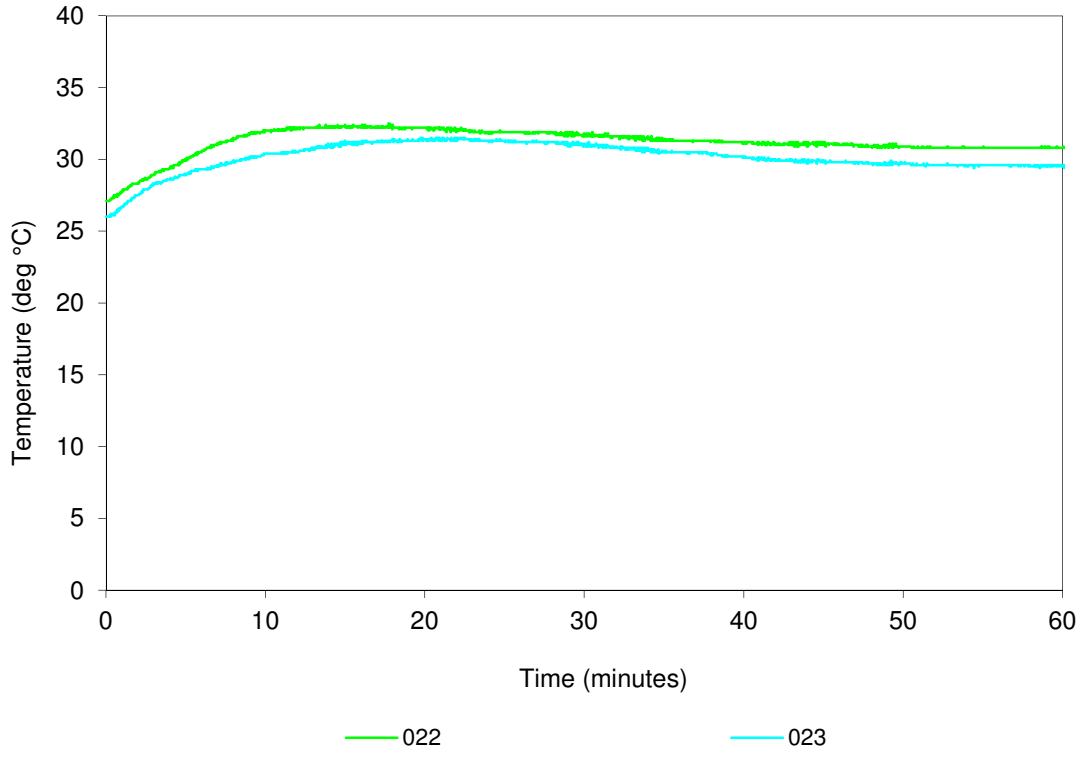


Figure 12 South crib – temperature vs time, unexposed around crib

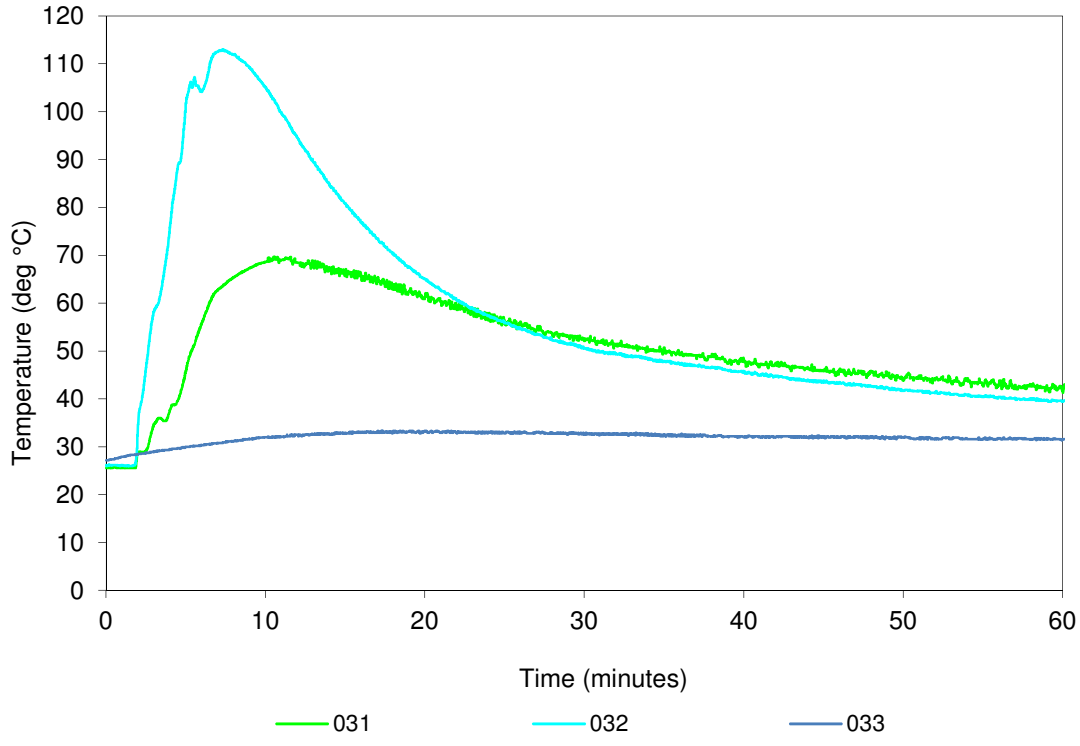


Figure 13 North crib – temperature vs time,

Table 11 Test specimen temperatures

Location	T/C no.	Description[2]	Temp (°C) at t (minutes)					Limit[1] (minutes)
			t=0	t=15	t=20	t=30	t=60	
Internal quarter points	011	Upper south quarter point	27	85	67	50	38	-
	012	Upper north quarter point	27	89	65	47	36	-
	013	Specimen centre	26	67	54	43	34	-
	014	Lower south quarter point	26	55	42	36	32	-
	015	Lower north quarter point	26	79	63	49	39	-
Internal quarter point average			26	75	58	45	35	-
External quarter points	024	Upper south quarter point	29	57	53	45	35	-
	025	Upper north quarter point	29	39	38	36	33	-
	026	Specimen centre	27	34	34	32	31	-
	027	Lower south quarter point	27	34	34	33	31	-
	028	Lower north quarter point	27	34	33	33	31	-
External quarter point average			28	39	38	36	32	-
Eaves	016	Eave above north window reveal	30	79	68	56	43	-
	017	Eave at middle of specimen	30	86	71	56	43	-
	018	Eave above crib	31	89	75	60	44	-
South crib	019	Centre of crib on internal of return wall	24	106	76	52	39	-
	020	Centre of crib on internal of rear wall	25	96	72	51	39	-
	021	Above mid-width of crib internal of rear wall	25	83	62	44	35	-
	022	Centre of crib on unexposed side of return wall	27	32	32	32	31	-
	023	Centre of crib on unexposed side of rear wall	26	31	31	31	30	--
North crib	031	Centre of crib on internal of rear wall	26	66	61	52	41	-
	032	Above mid-width of crib internal of rear wall	26	81	65	51	39	-
	033	Centre of crib on unexposed side of rear wall	27	33	33	33	32	-

Notes 1 Limit time is the time to the nearest whole minute, rounded down to the nearest minute, at which the temperature recorded by any surface thermocouple does not rise by more than 180K above the initial temperature, or the average of the external quarter point thermocouple measured temperatures does not rise by more than 140K above the initial temperature.

2 Refer to Appendix D for locations of thermocouples as only a generic description is included in the table.

[3] Limit time is the time to the nearest whole minute, rounded down to the nearest minute, at which the temperature recorded by any internal thermocouple does not reach 300°C, or the average of the internal quarter point thermocouple measured temperatures does not reach 250°C

[#] Thermocouple failure.

[‘–’] Under Limit column indicates the temperature limit was not exceeded during the test period or up until the time of integrity failure if a failure occurred.

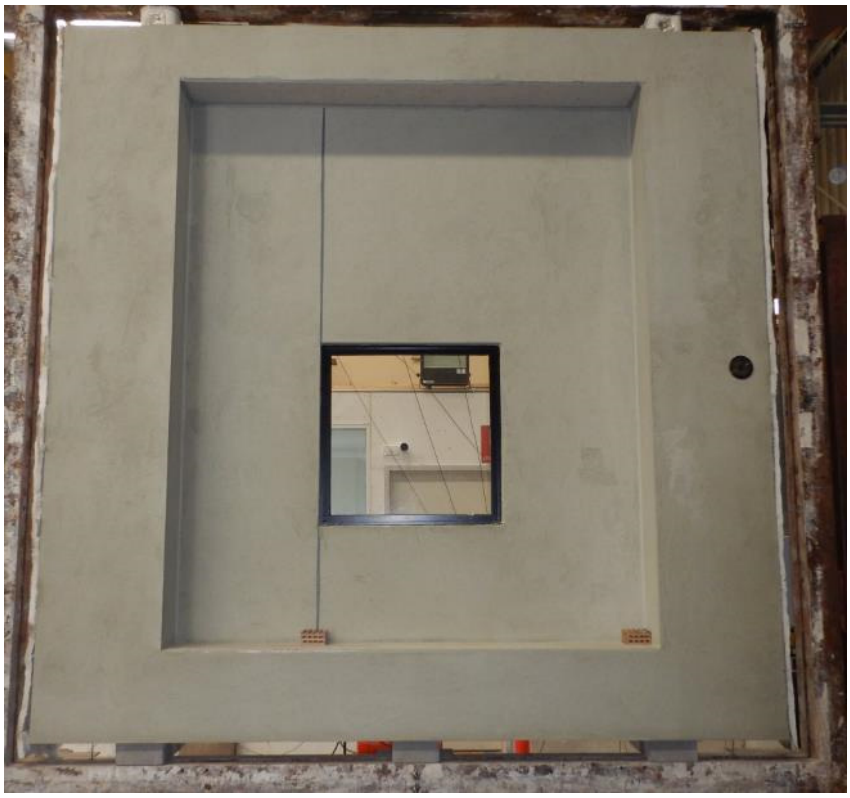
Appendix F Photographs

South

North

Figure 14 Unexposed face of specimen before the start of the bush fire test

North



South

Figure 15 Exposed face of the specimen before the start of the bush fire test

South

North

Figure 16 Unexposed face of specimen at the end of the bush fire test

North

South

Figure 17 Exposed face of the specimen at the end of the bush fire test